Remarks

Amendments

Claims 1, 11 and 21 have been amended to make explicit the fact that Applicant's symmetrical ground plane is a ***finite*** ground plane.

Claims 6, 16 and 23 have been amended to correct a spelling error.

No new matter has been added. Clearly, the specification as well as FIGs. 2a and 4a describe and show only ground planes that are finite and symmetrical (e.g., disk-shaped).

No amendments have been made to the specification or the drawing.

Claim Rejections – 35 USC 112

In paragraphs 2-3 of the Office action, Claims 2 and 12 have been rejected under 35 USC 112, first paragraph, as failing to comply with the enablement requirement. The Examiner states his position as follows:

> Despite applicant's disagreement, it remains the examiner's position that the limitation defining "the phase velocity being greater than the speed of light" still defies conventional theory of physics.

This rejection is once again respectfully traversed for several reasons. First, this rejection is fatally defective because it fails to provide Applicant with basic due process. The Examiner has not specified what ***conventional theory of physics*** he is relying on, and he has provided ***no scientific authority*** defining that theory and supporting his position. Second, let us assume, ***arguendo***, that the Examiner is relying on some notion that the speed of light (***c***) is the upper bound on the speed at which things (e.g., physical objects, electromagnetic waves) can travel through space. If so, the Examiner has either misunderstood or misapplied basics physics

principles as they relate to the ***phase velocity*** of an electromagnetic wave.

These basic physics principles are notoriously well known in the art. For example, the Examiner's attention is directed to the "Mathpages" Internet website at http://www.mathpages.com and, in particular, to the "Physics" section entitled "Phase, Group, and Signal Velocity." Pages 1-6 of that section are attached for the Examiner's convenience. Not only does Mathpages clearly define these three wave velocities, but also it clearly states that phase velocity is ***not*** limited by the speed of light; to wit:

(1) Page 2, lines 17-20: ***Since a general wave (or wavelike phenomenon) need not embody the causal flow of any physical effects, there is obviously there is no upper limit on the possible phase velocity of a wave***; and

(2) Page 4, lines 7-8: ***It is quite possible for the phase velocity...to exceed the value of c, because it conveys no information*** (in the case of a perfectly monochromatic wave of light); and

(3) Page 4, lines 27-28: ***Hence, not only is the phase velocity generally greater than c, it approaches infinity as ω approaches the cutoff frequency ω_0*** (in the case of a hollow magnetic conductor, often called a waveguide).

Although these citations from Mathpages should suffice to convince the Examiner that the phase velocity of a wave can exceed the velocity of light, Applicant submits two additional authorities both of which corroborate this fact: (i) J. D. Kraus, ***Antennas***, 2nd Edition, McGraw Hill, Inc., New York (1988), pp. 231, 291-293, and 759-760; and (ii) O. D. Jefimenco, ***Electricity and Magnetism***, 2nd Edition, Electret Scientific Company, Star City (1989), p. 553. Copies of these pages of Kraus and Jefimenco are also attached for the Examiner's convenience.

(1) Jefimenko, page 553, lines 23-27: ***It is interesting to note that the velocity with which these waves propagate, or their phase velocity...is $v_p = c/\sin\theta$ and thus is greater than the velocity of light*** (in the case of reflection at an angle θ from a conducting surface); and

(2) Kraus, page 291, Figure 7-26, shows that the relative phase velocity ***p*** can have values greater than one, where $p = v/c$ and v is the velocity along a conductor of a helical antenna; and

(3) Kraus, page 293, Figure 7-28, also shows that the relative phase velocity ***p*** can have values greater than one, where $p = v/c$ and v is the velocity along a conductor of a helical antenna; and

(4) Kraus, page 760, lines 11-12, provides an example where $v = 1.5c$ (in the case of a leaky waveguide antenna).

Mathpages, Kraus and Jefimenco are but three of many references that could be cited in support of the same principle. Accordingly, it should be apparent that electromagnetic waves having a phase velocity greater than the speed of light are notoriously well known in the art and do not violate any fundamental principles of physics.

Therefore, it is respectfully submitted that Applicants claims 2 and 12 satisfy the enablement requirement of 35 USC 112.

Moreover, inasmuch as these claims have not been rejected based on any prior art, it is respectfully submitted that they are patentable over the prior art of record.

Claim Rejections – 35 USC 102

In paragraphs 4-5 of the Office action, Claims 1, 3, 5-9, 11, 13 and 15-18 have been rejected under 35 USC 102(e) as being anticipated by M. C. Wicks et al., US Statutory Invention Registration, Reg. No. H2016H, published on April 2, 2002 and filed on March 5, 1986 (hereinafter ***Wicks***).

Regarding Claim 1, the Examiner's position is as follows:

> Wicks et al. teaches in figures 1-5 an antenna structure comprising: at least one antenna element [mono-blade antenna element], that at least one antenna element having at least one taper (See Figure 4); and a symmetrical ground plane [ground plane] (i.e. the ground plane extends to infinity, this makes the ground plane

symmetrical since extending to infinity is a form of translational symmetry.) coupled with the at least one antenna element [mono-blade antenna element].

This rejection is respectfully traversed for the reasons set forth below.

Lack of a Symmetrical Finite Ground Plane

A careful reading of Wicks makes it clear that he fails to teach a *symmetrical* ground plane, as required by Claim 1, lines 6-7. More specifically, in Figures 1 and 2a of Wicks the one-dimensional ground plane is shown schematically as a horizontal line, which is a typical depiction of an ***infinite*** ground plane. On the other hand, in Figure 4 of Wicks the ground plane is depicted in three-dimensions as an irregular plate, with the cut-away view again suggesting an *infinite* ground plane. Wicks provides no teaching regarding the shape of the ground planes of Figures 1, 2a and 4, and likewise provides no indication whatsoever that the ground planes are symmetrical. Lastly, in Figure 5 of Wicks the ground plane is depicted in three-dimensions as a rectangular plate. There are several reasons why this plate is not symmetrical as called for by Claim 1, lines 6-7. First, the schematic rendering of the plate of Figure 5 measures approximately 4" x 2.75", a ratio of 16:11, which is clearly rectangular and not symmetrical. Second, even if we assume, ***arguendo***, that the specific dimensions of the figure were not intended to be the actual dimensions (nor the ratio of such dimensions) of an operating embodiment, we are still left with the fact that Wicks is totally silent on the requirement of symmetry. Third, and perhaps most importantly, note that Wicks addresses the problems of ***aircraft*** communications antennas. It is well known in the art that in such aviation environments ***the ground plane is the body of the aircraft***, which means that the schematic renderings of the ground plane in Figures 1, 2a, 4 and 5 provide no indication of symmetry. Rather, Wicks as a whole tells one skilled in the art that the ground plane is the aircraft body, and that body is not symmetrical as called for by Claim 1 and as defined by Applicant's specification.

In addition, the Examiner relies on the notion that ***the ground plane extends to infinity, this makes the ground plane symmetrical since extending to infinity is a form of translational symmetry.*** This rejection is fatally defective because it fails to provide Applicant with basic due

process; that is, the reasoning is ***unsupported*** and ***inaccurate***. It is unsupported because the Examiner has cited no authority on the notion of translational symmetry. It is inaccurate because the notion of an infinite ground plane is a mathematical fiction. Therefore, the notion of symmetry existing at infinity due to some form of "translational symmetry" is also a mathematical fiction. No real symmetrical structures are taught by such a mathematical fiction. Since a real ground plane cannot be infinite, it must be finite and must have a well-defined shape. Yet, Wicks does not teach what that shape is and clearly does not teach that the shape is symmetrical.

Therefore, Wicks does not teach one skilled in the art to build an antenna structure that has a symmetrical ground plane, as required by Claim 1.

Finally, we note that claim 1, as amended, requires that the ground plane be ***finite***, so that even if we were to accept the Examiner's argument that Wicks' infinite ground plane is symmetrical, it is clearly not finite.

Accordingly, it is respectfully submitted that Wicks does not anticipate Claim 1.

Independent Claims 11 and 21, as amended, also require a symmetrical finite ground plane, and for the reasons set forth above are not anticipated by Wicks.

Parabolic Profile

Regarding dependent Claim 3, the Examiner argues that Wicks teaches in figures 1-5 the antenna structure wherein the taper comprises a ***parabolic profile***. This argument, however, conflicts with the explicit teaching of Wicks; to wit, the only description of the shape of the lower curved edge of his mono-blade antenna element appears at column 3, lines 17-44. In this section, Wicks clearly states that each curved segment (e.g., B to C, and C to D) constitutes ***an arc of constant radius*** (col. 3, lines 24-25). Since, an arc of constant radius defines a portion of a circle, it is clear that Wicks fails to teach or suggest that the curved segments of his antenna element are parabolic.

Accordingly, it is respectfully submitted that Wicks does not anticipate Claim 3.

Dependent Claim 13 also includes a parabolic profile, and for the reasons set forth above is not anticipated by Wicks.

Phase Velocity Greater than the Speed of Light

Wicks fails to teach that the antenna structure is a ***traveling wave antenna supporting a phase velocity greater than the speed of light***. In fact, Wicks teaches away from this feature of the invention; to wit, at column 2, lines 66-67 Wicks specifically teaches that the ***slot transmission line has a TEM mode of propagation***. As noted in Applicant's response of July 11, 2002, a TEM wave (or mode) is a *slow wave*, which means that its phase velocity is ***less than*** the speed of light, ***not greater than*** the speed of light as required by Claims 2 and 12. (See, Kraus, page 760, for a discussion of fast waves and slow waves.)

Claim Rejections – 35 USC 103

In paragraphs 5-6 of the Office action, Claims 10, 19, 21 and 23-25 have been rejected under 35 USC 103(a) as being unpatentable over Wicks, ***supra***, in view of Ogot et al., US Patent No. 5,648,787 (hereinafter ***Ogot***). The Examiner states his position as follows:

> Wicks et al. teaches every feature of the claimed invention except for the symmetrical ground plane is disk-shaped.
>
> Ogot et al. teaches in figure 3A the symmetrical ground plane [210, 250] is disk-shaped.
>
> It would have been obvious...to substitute the infinite ground plane as shown in Wicks et al. by using the symmetrical ground plane as taught by Ogot et al. in order to maximize the surface area of the ground plane perpendicular to the transmission element, and provides a uniform transmission pattern (See, col. 4, lines 66-67 and col. 5, lines 1-3).

This rejection is respectfully traversed. Wicks describes a ***broadband*** antenna (col. 1, line 11), which works best with a relatively large ground plane. Applicant and the Examiner agree on this point; i.e., the Examiner argues that the Wicks ground plane is infinite; Applicant has pointed out that Wicks relates to aircraft antennas in which the fuselage is the ground plane. In either case, the Wicks ground plane is much larger than the antenna elements. In contrast, Ogot describes a radar antenna in which the diameter of a circular ground plane is between $\lambda/8$ and $\lambda/4$ (col. 3, lines 20-23; col. 4, lines 61-64; col. 5, lines 11-21). By design, therefore, once the diameter of

the Ogot ground plane is set to satisfy one wavelength, it cannot simultaneously satisfy the same requirement for a wide range of wavelengths; e.g., it cannot simultaneously satisfy the $\lambda/8$ to $\lambda/4$ requirement over the ***many octaves of bandwidth*** demanded by the Wicks antenna (Abstract, line 2). Is clear, therefore, that Wicks and Ogot teach ***away*** from one another and that one skilled in the art would be motivated to substitute the Ogot narrow band circular disk ground plane for the Wicks broadband ground plane.

Accordingly, it is respectfully submitted that the combination of Wicks and Ogot fail to render obvious Applicant's Claims 10, 19, 21 and 23-25.

Allowable Subject Matter

Applicant again acknowledges and gratefully appreciates that the Examiner has indicated that Claims4, 14, 20 and 22 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

In view of the foregoing, reconsideration of claims 1-25, and passage of this application to issue, are hereby respectfully requested. If during the consideration of this paper, the Commissioner believes that resolution of the issues raised will be facilitated by further discussion, he is urged to contact the undersigned attorney at 610-691-7710 (voice) or 610-691-8434 (fax).

Respectfully,

George Earl Peterson

By _____
Michael J. Urbano
Attorney for Applicant(s)
Reg. No. 24, 522
610-691-7710

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